

FINAL REPORT TO OFFICE OF NAVAL RESEARCH ON  
CONTRACT Nonr-2813(00), No. 046-771

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AD 740668

1. Institution: Lick Observatory, University of California,  
Mount Hamilton, California
2. Principal Investigators: William P. Bidelman, Associate Astronomer,  
July 1, 1959 to August 31, 1962.  
S. Vasilievskis, Associate Astronomer,  
September 1, 1962 to June 30, 1963.
3. Title of Research: A Survey of M-type Dwarf Stars for Duplicity  
and other Research Dealing with Visual Double  
Stars.
4. Project Research Period: July 1, 1959 to June 30, 1963.
5. Progress Report: The progress for the period July 1, 1959 to  
June 30, 1961, has been reported by Dr. W. P. Bidelman, the  
initiator of the project. The present report, therefore, will  
cover only the remaining period from July 1, 1961 to June 30,  
1963. During these two last years, Dr. W. H. van den Bos was  
an Associate Research Astronomer under the Contract, and his  
accomplishments are as follows.

a) Micrometer measurements of double stars were made  
with the Lick 36-inch and 12-inch refractors. The number of  
measurements is as follows:

|                    |                   |                   |
|--------------------|-------------------|-------------------|
| 7-1-61 to 6-30-62: | With 36-in. refr. | 4297 meas.        |
| 7-1-62 to 6-30-63: | With 36-in. refr. | 4348 meas.        |
| <u>Total</u>       |                   | <u>8645 meas.</u> |
| 7-1-61 to 6-30-62: | With 12-in. refr. | 1985 meas.        |
| 7-1-62 to 6-30-63: | With 12-in. refr. | 2297 meas.        |
| <u>Total</u>       |                   | <u>4282 meas.</u> |

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The 12,927 measurements in two years constitute an all-time  
record in the history of double star astronomy. The quantity,  
however, is not the only distinction of this achievement. Dr.  
van den Bos is a leading double star observer in the world,  
and his measurements have been and will be of fundamental im-  
portance in research on double stars, because of their quality.

It may be also mentioned that recent improvements of the 36-  
inch telescope, particularly the dials for rapid and accurate  
setting, have contributed to the success. The undersigned tried  
to assign as much as possible the 36-inch telescope for the  
project.

DISTRIBUTION STATEMENT A

Approved for public release;  
Distribution Unlimited

The measurements are published: I. A. J., 67, 141, 1962; II. A. J., 67, 555, 1962; III. A. J., 68, 57, 1963. The fourth and final publication is in press.

b) A few double star orbits were computed by Dr. van den Bos and published as follows: one orbit in J. O., 45, 55, 1962, and three orbits in A. J., 67, 552, 1962.

c) Dr. van den Bos devoted a considerable part of his time to compilation of the Double Star Index Catalogue to be published soon. Dr. H. N. Jeffers has the general responsibility, but the Catalogue could not cover the entire sky without participation of Dr. van den Bos.

d) Miscellaneous articles on double stars have been published by Dr. van den Bos during the period of the project: PASP, 74, 291, 1962, and PASP, 74, 297, 1962.

Mt. Hamilton, California  
July 15, 1963

S. Vasilevskis  
Principal Investigator

BRIEF STATEMENT OF ACCOMPLISHMENTS TO  
DATE UNDER CONTRACT Nonr-2813(00) WITH  
THE OFFICE OF NAVAL RESEARCH

The contract Nonr-2813(00) between the Regents of the University of California and the Office of Naval Research has resulted in a very substantial increase in our knowledge in the field of visual double stars. Under this contract two skillful visual double star observers have carried out extensive micrometric measurements of visual double stars with the 36-inch and 12-inch refractors of the Lick Observatory since July 1, 1959: Mr. Charles E. Worley (July 1, 1959 to June 30, 1961) and Dr. W. H. van den Bos (July 1, 1961 to date). In addition to making over 3100 double star measures, as yet largely unpublished, Mr. Worley surveyed 700 M dwarf stars for duplicity, discovering 28 new double stars among them, some of great interest. He also carried out photometric measurements with the Muller polarizing photometer of the differences in magnitude of some 90 close binaries, and prepared for publication a valuable new catalogue of double star orbits, a total of 619 orbits of 516 binaries being included.

Dr. van den Bos, past director of the Union Observatory, Johannesburg, South Africa, has made over 2100 visual double star measures with the Lick refractors in the months of July, August, and September, 1961, a truly remarkable figure, especially when one considers that the telescopes have not been available on a full-time basis for this work. A paper containing somewhat less than one-half of these measures is now awaiting submission to the Astronomical Journal.

Publications resulting from the contract:

C. E. Worley: Measures of 241 Double Stars, A.J., 65, 156, 1960.  
Thirteen New Double Stars, P.A.S.P., 72, 125, 1960.  
The Orbit of BD +27°2853(AN), P.A.S.P., 72, 504, 1960.  
Thirteen New Double Stars, P.A.S.P., 73, 167, 1961.  
Visual Observing of Double Stars,  
Sky and Telescope, 22, 73, 1961.  
The Construction of a Filar Micrometer,  
Sky and Telescope, 22, 140, 1961.

October 20, 1961

William P. Bidelman  
William P. Bidelman, Chief Investigator

During the interval July 1, 1959 to May 15, 1960, visual observations with the 12-inch and 36-inch refractors have been made on 108 nights of seeing 2 or better. Details of these observations and of my other activities are summarized below.

1. Survey of M-dwarf stars for duplicity.

The major portion of my observing time with the 36-inch refractor has been spent on this program. The observing list consists of all known M-dwarf stars accessible to the telescope: these stars number 805. Among these stars, counting known spectroscopic binaries and wide common proper motion pairs as well as close visual binaries, some 170 multiple stars were previously known.

At the present time 573 stars have been examined, and 21 new double stars added to those previously known. A number of additional pairs, outside the separation limit chosen for the present survey (15 seconds of arc), have also been noted. A list of 13 new doubles has just been published (Pub. A.S.P., 72, 125, 1960.). Some 60 of the stars already examined are not considered "finished", either because the seeing was not satisfactory or because they are doubles in process of measurement.

Of interest is the fact that, among the 21 new doubles, six have separations less than one second and another six have separations between one and two seconds. Several of these pairs may prove to be binaries in rapid orbital motion.

2. Measures of companions to bright stars.

Some 300 measures of companions to bright stars have been made with both telescopes. This program has necessarily received secondary priority with the 36-inch telescope, but the substantial completion of the M-dwarf program will allow more time for these objects in the future.

3. General double star measures.

Over 300 measures have been made with the 36-inch telescope, the majority of these of M-dwarf pairs.

More than 900 measures have been made with the 12-inch telescope. A list containing 1062 measures made from Sept. 1956 to Dec. 1959 is in press.

#### 4. Orbit catalog.

A new general catalog of orbits of visual binaries is substantially complete. This catalog contains 500 orbits, twice the number in the last general catalog published only ten years ago.

#### 5. Magnitude-difference program.

Some experimental measures with the Muller-type polarizing photometer have been made in order to test the equipment and to obtain practice in its use. Regular observations will begin after July 1, 1960.

Charles E. Worley

Charles E. Worley  
(contract employee actually responsible for the work being carried out)

William P. Bidelman

William P. Bidelman  
(principal investigator)

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